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DEPARTMENT OF ECOLOGY

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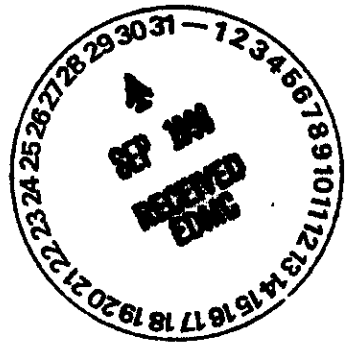
September 16, 1998



Mr. Marvin J. Furman
U.S. Department of Energy
P.O. Box 550, MSIN: HO-12
Richland, WA 99352

Dear Mr. Furman;

Re: Comments on "Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas S-SX at the Hanford Site" January 1998 (PNNL-11810)

49585

The Washington State Department of Ecology (Ecology) has initiated its review of the above document. The number of comments generated thus far has prompted Ecology to provide you with the enclosed list of completed comments. Ecology believes this transmittal will give the U.S. Department of Energy (USDOE) and its contractors sufficient direction to begin revising the document. As can be observed from the enclosed comments, substantial editing of this document is necessary. Additional comments may be forthcoming as Ecology completes its review.

Ecology will also provide comments on the remaining Single-Shell Tank Groundwater Quality Assessments that USDOE has transmitted to Ecology. Ecology expects, however, that many of the issues identified in the enclosed comments will also be applicable to this other document.

If you have any questions, please contact Alex Stone (Storage) at (509) 736-3018 or Suzanne Dahl (Disposal) at (509) 736-5705.

Sincerely,

Suzanne Dahl
TWRS Disposal Project Manager
Nuclear Waste Program

Dr. Alex Stone
TWRS Disposal Project Manager
Nuclear Waste Program

SD:AS:sb
Enclosure

cc: Maureen Hunemuller, USDOE
Bob Lober, USDOE
Mike Thompson, USDOE
Doug Sherwood, EPA
Janice Williams, FDH
Dave Myers, LMHC
Jim Bertsch, MACTEC-ERS
Stuart Harris, CTUIR
Stan Sobczyk, NPT
Wade Riggsbee, YIN
Merilyn Reeves, HAB
Mary Lou Blazek, OOE
Administrative Record: SST TSD S-2-4 and Vadose Zone Characterization

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"Results of Phase I Groundwater Quality Assessment for Single-Shell Tank Waste Management Areas S-SX at the Hanford Site" January 1998 (PNNL-11810) Ecology Review Comments (July – August 1998)

1. Page iii. Why reference FFCA? Does it set standards for RCRA phase 1? Please reference appropriate CFR and WAC.

2. Page iii, Summary, 1st paragraph. The term "Phase I" has no regulatory basis. Delete the term and insert the applicable regulatory citation. Recommended wording is: "Pacific Northwest National Laboratory conducted a "first determination" groundwater quality assessment for the U.S. Department of Energy, Richland Operations Office, in accordance with 40 CFR 265.93(d)(4) by reference of WAC 173-303-400(3)."

3. Page iii, Summary, 1st paragraph. It is recommended that an additional sentence be added to the first paragraph that reflects the regulatory status of the groundwater-monitoring program. Recommended wording is: "This report documents the first determination evaluation of 40 CFR 265.93(d)(4) and describes the assessment monitoring program of 40 CFR 265.93(7)(i)."

4. Page iii, Summary, 2nd paragraph. As Washington Administrative Code (WAC) 173-303-040 defines "ancillary equipment", insert the words "equipment and" between the words "ancillary" and "waste systems" in the first sentence.

5. Page iii, Summary, 2nd paragraph. The second sentence identifies the date the unit was "placed in the assessment groundwater monitoring program" as August 1996. A review of the downgradient groundwater data from RCRA and non-RCRA wells indicates groundwater contamination occurring as early as 1986. Therefore, it is recommended that the summary not identify that the assessment monitoring program was not initiated until August 1996. It is recommended the second sentence read "The unit is regulated under RCRA interim-status regulations (40 CFR, Subparts J and F, by reference of WAC 173-303-400(3)) and was placed in assessment groundwater monitoring (40 CFR 265.93(d)(4)) after elevated waste constituent and indicator parameter measurements/observations (i.e., specific conductivity, chromium, technetium-99, etc.) in S-SX WMA downgradient monitoring wells were repeatedly observed and confirmed."

6. Page iii, Summary, 2nd paragraph. The term "Phase I" has no regulatory basis. Delete the term in the last sentence of the paragraph and insert the applicable regulatory citation. Recommended wording is: "The first determination, allowed under 40 CFR 265.93(d), provides the owner-operator of a facility with an opportunity to demonstrate that the regulated unit is not the source of groundwater contamination."

7. Page iii, Summary, 3rd paragraph, 1st bullet. As the radionuclides represent constituents of the waste and "RCRA" is synonymous with "dangerous waste", recommended wording for the first sentence is: "Distribution patterns for waste constituents indicate the WMA S-SX has contributed to and/or been the source of groundwater contamination observed in downgradient monitoring wells."

8. Page iii, Summary, 3rd paragraph, 1st bullet. As the groundwater and vadose zone data is sufficient to make the first determination, recommended wording for the second sentence is: "It is concluded that multiple source locations in the WMA exist to explain the observed spatial and temporal groundwater contamination patterns."

9. Page iii, 2nd bullet: There is no "interim" drinking water standard in the regulation. Remove the word "interim".

10. Page iii, Summary, 3rd paragraph, 2nd and 3rd bullets. Due to the volume of data and the spatial and temporal groundwater contamination patterns observed thus far, the second and third bullets should be re-written to discuss just one constituent per bullet. In addition, due to the direction of groundwater flow and the location of the "RCRA" downgradient monitoring wells, the observations should not be limited to "RCRA" wells. The discussion should also not be limited to "current" observations. Many data exist which add value to the summary discussion. Some recommended wording is: "Drinking water standards for technetium-99 have been and currently are exceeded in S-SX WMA downgradient monitoring wells. Technetium-99 concentrations at well 299-W22-46, located at the southeastern corner of the SX tank farm, have been observed (from November 1996 to February 1998) to exceed the U.S. Environmental Protection Agency (EPA) interim drinking water standard (DWS) of 900 pCi/L up to a factor of five times. Technetium-99 concentrations at a non-RCRA well 299-W23-1 (located inside the S tank farm) have also been observed (from June 1986 to May 1998) to exceed the DWS up to a factor of nine times. Similarly, technetium-99 concentrations at another non-RCRA well 299-W23-7 (located northeast of the SX tank farm) have also been observed (from September 1987 to January 1991) to exceed the DWS up to a factor of eight times. Similarly, technetium-99 concentrations at another non-RCRA well 299-W23-2 (located inside the SX tank farm) have also been observed (from December 1987 to September 1994) to exceed the DWS up to a factor of 6 times. Technetium-99 concentrations at another RCRA well 299-W22-45 have recently been observed to be significantly increasing from previously measured concentrations (November 1992 to August 1996) to more than one-half the DWS (427 pCi/L on May 12, 1998)."

11. Page iii, Summary, 3rd paragraph, 2nd and 3rd bullets. Due to the volume of data and the spatial and temporal groundwater contamination patterns observed thus far, the second and third bullets should be re-written to discuss just one

constituent per bullet. In addition, due to the direction of groundwater flow and the location of the "RCRA" downgradient monitoring wells, the observations should not be limited to "RCRA" wells. The discussion should also not be limited to "current" observations. Many data exist which add value to the summary discussion. Some recommended wording is: "Drinking water standards of 10 mg/L for nitrate have been and currently are exceeded in S-SX WMA downgradient monitoring wells. Observations of nitrate concentrations at RCRA well 299-W22-46 have exceeded the DWS from 1992 to 1997 (data beyond November 1997 are currently unavailable) with what may appear to be a peak measurement in May 1997. Similarly, the DWS for nitrate has also been exceeded at RCRA downgradient well 299-W22-45 from 1995 to 1997. At this well, the nitrate measurements have consistently increased from February 1996 to November 1997. Similarly, the DWS for nitrate has also been exceeded at RCRA downgradient well 299-W22-39 from 1991 to 1996. At this well, little variation of nitrate concentration has been observed. The DWS for nitrate has also been exceeded at non-RCRA downgradient well 299-W23-2 (located within SX tank farm) from 1987 to 1996 (data beyond March 1996 unavailable) with a peak measurement in September 1994. Similarly, the DWS for nitrate has also been inconsistently exceeded at non-RCRA downgradient well 299-W23-3 (located at southeastern corner of and within SX tank farm) from 1957 to 1995 with a peak measurement in November 1961."

12. Page iii, Summary, 3rd paragraph, 2nd and 3rd bullets. Due to the volume of data and the spatial and temporal groundwater contamination patterns observed thus far, the second and third bullets should be re-written to discuss just one constituent per bullet. In addition, due to the direction of groundwater flow and the location of the "RCRA" downgradient monitoring wells, the observations should not be limited to "RCRA" wells. The discussion should also not be limited to "current" observations. Many data exist which add value to the summary to discuss. Some recommended wording is: "Drinking water standards of .05 mg/L for chromium have been exceeded in the RCRA downgradient wells 299-W22-39, 299-W22-44, and 299-W22-46 and in the non-RCRA downgradient well 299-W23-7. Due to the filtration of samples and in particular, the filtration of the most recent samples (typically from March 1994 to February 1998) a trend analysis cannot be performed."

13. Page iii, Summary, 3rd paragraph, 4th and 5th bullets. Due to the volume of data and the spatial and temporal groundwater contamination patterns observed thus far, the fourth and fifth bullets should be re-written to discuss all data available. In addition, due to the direction of groundwater flow and the location of the "RCRA" downgradient monitoring wells, the observations should not be limited to "RCRA" wells. Much data exists which add value to the summary discussion. Some recommended wording is: "Drinking water standards of 200 pCi/L for cesium-137 and 8 pCi/L for strontium-90 have not been exceeded in the RCRA or non-RCRA downgradient wells. Although concentrations of cesium-137 were

measured in well 299-W22-39 from November 1991 to July 1992, in well 299-W22-44 in October 1994, in well 299-W22-45 in April 1993, they have been low ranging from .52 to 6.5 pCi/L. The cesium-137 concentrations measured in non-RCRA well 299-W23-7 (located inside and between the S and SX tank farms) from September 1994 to June 1996 are an exception and ranged from relatively low values of 1.97 pCi/L to a high of 21.8 pCi/L. Similarly, strontium-90 concentrations have not been detected in any well with the exception of non-RCRA well 299-W23-7 from March 1996 to June 1996. In this well, strontium-90 concentrations have ranged from .869 to 6.153 pCi/L. With the exception of well 299-W23-7, these observations are consistent with the expected low mobility of these constituents under Hanford Site conditions. Additional investigation is needed to determine the extent of Cs-137 and Sr-90 contamination related to well 299-W23-7 observations."

14. Page iv, Paragraph 3 from preceding page, 3rd bullet. The term "Phase II" has no regulatory meaning. Recommended wording for the sentence is: "Further determinations required by 40 CFR 265.93(d)(7)(i) [by reference of WAC 173-303-400(3)] will be made and are described in Chapter 6 of this report."

15. Page iv, last bullet: Phase II investigation should include nature and extent and sources of contamination within groundwater and vadose zone.

16. Page 1.1, Section 1.0, 1st paragraph. The term "Phase I" in the first sentence has no regulatory meaning. Also, the report should cite the applicability of the Washington Administrative Code. Recommended wording is: "This report presents the findings and conclusions of the first determination, *Resource Conservation and Recovery Act of 1976* (RCRA) groundwater quality assessment of Single Shell Tank Waste Management Area (WMA) S-SX as required by 40 CFR 265.93(d) (by reference of WAC 173-303-400(3))."

17. Page 1.1, Section 1.0, 1st paragraph. Due to the considerable volume of data and information which may precede PNNL's efforts which occurred from August 1996 to July 1997, it is appropriate to also identify the data considered during the assessment includes all useable data from all wells. In other words, certain (non-RCRA) wells were installed much earlier than the stated assessment period and meaningful information can be obtained from the consideration of the data collected prior to August 1996. Therefore, the period should at least be inclusive of the time when contamination was first detected in a downgradient monitoring well. For example, from well 299-W23-7, significantly elevated gross beta was measured in June 1987 and grossly elevated technetium-99 was measured in September 1987. Similarly, from well 299-W23-1, elevated gross beta was measured in March 1959 and grossly elevated technetium-99 was measured in June 1986. It should be noted that technetium-99 for well 299-W23-1 was first measured on June 23, 1986. Related to the most recent data used, as Ecology has taken more than six months to review this document, it is requested the data

period be extended to December 1998. Therefore, recommended wording for the second sentence is: "Pacific Northwest National Laboratory conducted the assessment from August 1996 to July 1997 using data collected between the early 1970's and December 1998.

18. Page 1.1, Section 1.0, 1st paragraph, 2nd bullet. For consistency with WAC 173-303-040, insert the words "equipment and" between "ancillary" and "waste systems".

19. Page 1.1, Section 1.1. Please note that these active TSD units are not in compliance with RCRA and appropriate WAC Code, but are allowed active status under the Hanford Federal Facility Agreement and Consent Order (Tri-Party Agreement).

20. Page 1.1, Section 1.1. Nature of extent contamination determination is not just within groundwater, but also the vadose zone.

21. Page 1.1, Section 1.1, 1st paragraph. Include the applicable regulatory cite for management of the tanks. Recommended wording is: "The tanks and ancillary equipment in WMA S-SX are RCRA treatment and storage units managed in accordance with Title 40, Code of Federal Regulation (CFR) Part 265, Subparts F and J (40 CFR 265.92 and 265.196 [by reference of Washington Administrate Code (WAC) 173-303-400(3)]. In addition, the units will be closed in accordance with WAC 173-303-610."

22. Page 1.1, Section 1.1, 2nd paragraph. The term "detection monitoring program" is typically used in reference to final facility status monitoring program for which no contamination from the regulated unit has been detected. Change "A detection-level groundwater monitoring program" to "An indicator parameter monitoring program".

23. Page 1.1, Section 1.1, 2nd paragraph. As groundwater monitoring occurred for WMA S-SX long before 1990, insert the word "administratively" between "was" and "initiated" in the first sentence.

24. Page 1.1, Section 1.1, 2nd paragraph. As the assessment-monitoring program could have been initiated much earlier than 1996, insert the word "administratively" between "was" and "placed" in the second sentence. Also, identify which WMA tank system unit Ecology's 1996 directive was addressing.

25. Page 1.1, Section 1.1, 3rd paragraph. There is no regulatory basis for the term "Phase I". In addition, the first sentence is describing how the regulations are typically applied. For reasons, perhaps not beneficial to describe, the WMA S-SX unit's initiation of assessment monitoring was incorrectly delayed. Similarly, the unit's first determination may be considered to have been performed over an

extended duration. Recommended wording for the first sentence is: "The first determination, and the subject of this report, is typically a short-term sampling program intended to provide the owner/operator an opportunity to substantiate a false positive claim."

26. Page 1.1, Section 1.1, 3rd paragraph. Re-write the second sentence as: "If the owner/operator determines, based on the results of the first determination, that no dangerous waste and/or dangerous waste constituents from the unit have entered the groundwater, then he may reinstate the indicator parameter monitoring program (40 CFR 265.93(d)(6)).

27. Page 1.1, Section 1.1, 3rd paragraph. Re-write the third sentence as: "If, however, contamination is confirmed (i.e., the regulated unit is the source of groundwater contamination), then further determinations are required under 40 CFR 265.93(d)(7)(i)."

28. Page 1.1, Section 1.1, 3rd paragraph. Re-write the fourth sentence as: "In addition, information gained during the assessment monitoring program (including the further determinations), could be used to evaluate corrective measures."

29. Figures 1.1, 1.2, 3.6, and 3.7. The figures don't appear to include pertinent ancillary equipment. In particular, at least one figure should show where unplanned releases have occurred in relation to the management of the S-SX tanks and/or ancillary equipment. For example, as an unplanned release occurred around the 241-S-151 diversion box, this area denoted on a figure would provide pertinent information to this assessment. Table 3 of *Vadose Zone Characterization Project at the Hanford Tank Farms SX Tank Farm Report* (DOE/ID/12584 GJPO-HAN-4, September 1996) describes unplanned releases associated with the management of the SX tank farm and Figure 2 of the same report identifies the locations of more than a dozen releases.

30. Figure 1.2. A comparison of the well numbers shown on Figure 1.2 and the wells described in Appendix D of *Assessment Groundwater Monitoring Plan for Single Shell Tank Waste management area S-SX* (WHC-SD-EN-AP-191, Rev. 0) was performed. The referenced document identifies well numbers 299-W22-6, 299-W22-16, and 299-W23-8, which do not appear to be shown on Figure 1.2. Well number confirmation and inclusion on Figure 1.2, if applicable, is requested.

31. Figure 1.2. Figure 2 of *Vadose Zone Characterization Project at the Hanford Tank Farms SX Tank Farm Report*, September 1996, DOE/ID/12584-268 GJPO-HAN-4, shows 216-S-8 trench located just northeast of tank 104. Figure 1.2 shows 216-S-8 trench located southeast of tank 104. Similarly, Figure 1.2 shows well 299-W22-39 located just west of 216-S-8 trench and Figure 2 shows well

299-W22-39 located approximately 200 feet south of 216-S-8 trench. Confirm the accuracy of Figure 2's location of 216-S-8 trench and well 299-W22-39.

32. Page 1.3, Section 1.2, 1st paragraph. In the first sentence, include the identification that observed contamination concentrations were also considered. Recommended wording is: "....if observed concentrations of contaminants and changes in groundwater quality....".

33. Page 1.3, Section 1.2, 1st paragraph. Change "Phase I" to "first determination" in the second sentence.

34. Page 1.3, Section 1.2, 2nd paragraph. As this report represents the first determination of the assessment monitoring program, it should not be limited to a description of "new information". Recommended wording for the first sentence is: "The scope of this report focuses on new information acquired in connection with the first determination assessment.

35. Page 1.3, Section 1.3, 1st paragraph. Change "Phase I" to "first determination" in the first sentence.

36. Page 2.1, Section 2.0, 1st paragraph. Change "Phase I" to "first determination" in the first sentence.

37. Page 2.1, Section 2.0, 1st paragraph. The use of a DQO process is described whereby a conceptual model will be generated as the investigation continues. The second sentence of this paragraph should be moved to Chapter 6 of this document. The further determination actions (required by 40 CFR 165.93(d)(7)(i)) should be described in detail in Chapter 6.

38. Page 2.1, Section 2.0, 2nd paragraph. Change "Phase I" to "first determination" in the first sentence.

39. Page 2.1, Section 2.1.1. What Does CWR stand for?

40. Page 2.5, Section 2.2. Please discuss the leak volumes for S/SX tank farm. Also, add a discussion of the Agnew report on the underestimation of releases from this tank farm.

41. Pages 2.5-2.5, Section 2.2. Section 3.8 (page 3.18) appears to describe contaminant transport as a plume. The vadose zone characterization information from BX, BY, TX, TY, T and SX suggests that contamination has moved as broad, low-activity plumes. While Section 3.8 appears to be describing this conceptualization, it does not do so clearly. Similarly, Section 2.2 does not appear to include this conceptualization, but rather, it emphasizes the non-homogeneous nature of the sedimentary units beneath the units as playing an important role in

contaminant movement. Similarly, Figures 3.9 and 3.10 emphasize this concept by implying the stratigraphic layers control contaminant transport. Include a conceptualization of plume migration in a relatively homogeneous fashion. It should be noted that this concept does not negate, but rather compliments, the expert panel's concept. The voluminous vadose zone characterization information may be referenced in relation to the "relatively" homogenous plume migration concept.

42. Page 2.4, Section 2.1.1, 3rd and 6th paragraphs. Figure 1.2 is identified as showing SX tank farm leakers but does not appear to identify designated leakers. Figure 3.6 shows designated leakers and would be a better figure to reference.

43. Page 2.4, Section 2.1.1, 6th paragraph. Delete the word "potential" in the first sentence, as there is no question that groundwater beneath the S-SX WMA has been and remains contaminated.

44. Page 2.4, Section 2.1.1, 6th paragraph. Although considerable vadose zone characterization information has been documented, only two DOE reports are referenced in the last sentence of the paragraph. The following additional reports/documents should also be referenced and/or discussed in this assessment: 1) *Tank Summary Data Report for Tank SX-102*, October 1995 (GJ-HAN-6, Tank SX-102), 2) *Tank Summary Data Report for Tank SX-108*, November 1995 (GJ-HAN-10, Tank SX-108), 3) *Tank Summary Data Report for Tank SX-109*, December 1995 (GJ-HAN-11, Tank SX-109), 4) *Tank Summary Data Report for Tank SX-110*, December 1995 (GJ-HAN-12, Tank SX-110), 5) *Tank Summary Data Report for Tank SX-110*, December 1995 (GJ-HAN-13, Tank SX-111), 6) *Tank Summary Data Report for Tank SX-115*, January 1996, (GJ-HAN-17, Tank SX-115), 7) *Assessment of Log Data for Borehole 41-09-39 and Correlation With Borehole 41-09-04 in the SX Tank Farm*, March 1997 (GJO-97-4-TAR, GJO-HAN-9) and 8) *Reassessment of the Vadose Zone Contamination at Tank SX-104 and a Comparison to the 1995 Baseline*, April 1998 (GJO-98-48-TAR, GJO-HAN-21).

45. Page 2.5, Section 2.1.1, paragraph from preceding page. Insert "groundwater and/or" between "contributors to" and "vadose zone contamination" in the first complete sentence on the page.

46. Page 2.5, Section 2.1.2, 1st and 2nd paragraphs. The possible dissolution and precipitation of silica and aluminum in the soil column is discussed/described. An identification of an unusually high silica percentage in drill cuttings (at depth) has not been made. Include the identification of all applicable observations from drill cuttings (i.e., the observation(s) of the occurrence of high silica content, the observation(s) of occurrence of average silica content, and/or the observation(s) of low silica content). It is noted that the proposed activities as described in the *Assessment Groundwater Monitoring Plan for Single Shell Tank Waste*

management Area S-SX (WHC-SD-EN-AP-191, Rev. 0) do not appear to specifically collect silica content observations. Nonetheless, if observations were made, include them and if no observations were made, include the identification of this status.

47. Page 2, Section 2.1.2, First and second paragraph. It is an established fact that multi-molar high caustic liquids dissolve silica and aluminum. Under vadose conditions, we should expect precipitation of these materials at depth (silica nodules, colloidal silica, silica as binding cement, etc.). Did we observe any unusually high silica percentages in drill cuttings at depth? If this was not observed, it is highly probable that the entire mass of tank leakage have moved downward as a wetting front. This wetting front need not necessarily be as broad as mentioned in the text.

48. Page 2.5, Section 2.1.2, 2nd paragraph. Identify the basis for the descriptor "broad" used in the first sentence in relation to the "wetting front". The basis should be included in the text discussion.

49. Page 2.2, Figure 2.1. While the conceptualized model of contaminant transport through the soil to the groundwater correctly identifies contaminated groundwater, which satisfies the purpose of the first determination, it appears the model is greatly simplified. Although the model is identified as representing spills/leakage during the 1960's (with subsequent movement of contaminants shown in single colors based on the likely rate of transport through the soil), it does not communicate that there have been numerous releases in and around the S-SX WMA beginning in the 1950's to the last documented unplanned release in 1980. While it is accurate to depict groundwater contamination of mobile constituents, less mobile constituents have also been observed in groundwater. In particular, cesium-137 and strontium-90 have been measured numerous times in the groundwater at several locations. In addition, the contaminant transport is greatly complicated by the potential complex geochemical reactions occurring in the subsurface, the complex configuration of tank ancillary equipment, numerous spills and/or leaks which have occurred in and near the S-SX WMA, etc. Perhaps the most deficient aspect about the conceptualized model is that it doesn't accurately depict that releases have occurred numerous times and each time potentially re-starting and/or promoting contaminant transport. Using overlays that depict the passage of time and new occurrences may best depict such a re-occurring contaminant front moving through the vadose and into the groundwater. At a minimum, the figure must identify that the conceptualized model is a simplified one that only depicts one potential "generation" of contaminant transport through the vadose zone.

50. Page 2.5, Section 2.1.2, 4th paragraph. Insert the words "(S-SX tank system ancillary equipment) between "outlets of the tanks" and "also contributed to".

51. Page 2.6, Section 2.2, 1st full paragraph. The second sentence states "five wells were drilled to groundwater in the S and SX farms, three of which are adjacent to tanks". According to Figure 1.2 and information contained in the *Assessment Groundwater Monitoring Plan for Single Shell Tank Waste management Area S-SX* (WHC-SD-EN-AP-191, Rev. 0), there are six groundwater wells in the S and SX farms, four of which are adjacent to tanks.

52. Page 2.6, Section 2.3, 1st paragraph. Change the wording in the first sentence to include spills and leaks of water and/or wastes. Recommended wording is: "....or a leak and/or spill (water and/or waste) of sufficient....".

53. Page 2.6, Section 2.4, 1st paragraph. Change the word "co-contaminants" to "constituents" in the second sentence.

54. Page 2.6, Section 2.4, 1st paragraph. Insert "While radionuclide constituents contribute to the toxic dangerous waste designation," at the beginning of the sentence. In addition, change "hazardous waste constituents (or listed wastes)" to "toxicity characteristic contaminants" in the third sentence. Recommended wording for the third sentence is: "While radionuclide constituents contribute to the toxic dangerous waste designation, the latter two constituents are RCRA toxicity characteristic contaminants."

55. Page 2.6, Section 2.4, 1st paragraph. The fourth sentence implies that past-practice discharges of tritium-bearing tank condensate have occurred upgradient from all S-SX WMA groundwater monitoring wells. From information available, it appears the tritium-releasing unit of reference is the 216-S-25 crib. It may be concluded that the crib is directly upgradient from the SX tank farm and upgradient from only part of the S tank farm. Therefore, recommended wording for the fourth sentence is the following: "Tritium also is present in the tank waste, but a much larger tritium source (past-practice tritium-bearing tank condensate discharges to 216-S-25 crib) has been located directly upgradient from the SX tank farm (*Hanford Site Groundwater Monitoring for Fiscal Year 1997*, Plate 3).

56. Page 2.6, Section 2.4, 1st paragraph. It is noted that 216-S-25 crib is directly upgradient from SX tank farm and upgradient from only part of S tank farm. The tritium plots for the 1995, 1996, and 1997 Hanford Site groundwater monitoring reports (Plate 3) appear to be indicating an upward tritium trend in the area near well 299-W23-1. The same upward trend does not appear to be observed near upgradient well 299-W23-13 (located between upgradient tritium source 216-S-21 and S-SX WMA). As such, include a discussion of the tritium plume, the tritium to technetium-99 ratios, and the expectations associated with the hydraulic conductivity at well 299-W23-1. In particular, if there is a basis for the implied groundwater flow direction perturbation, include the basis.

57. Page 2.7, Section 2.4, 1st paragraph. Change the word "co-contaminants" to "constituents" in the first sentence.

58. Chapter 3. A section, which describes the groundwater monitoring network, should be inserted into this report. While it is appropriate to reference previously published documents for detailed information (i.e., *Assessment Groundwater Monitoring Plan for Single Shell Tank Waste management Area S-SX* (WHC-SD-EN-AP-191, Rev. 0), without discussion and/or explanation, various erroneous conclusions may be drawn from the report. For example, considering certain text, figures and plots provided in the report, it appears to imply that monitoring well 299-W22-44 is "downgradient" to the S-SX WMA. While certain figures clearly show the expected path of groundwater plume migration (Figure 4.1) to be away from well 299-W22-44, other figures imply the well is downgradient (Figures 3.1 and 3.3). It is noted that well 299-W22-44 would not satisfy compliance point monitoring of WAC 173-303-645. Similarly, monitoring well 299-W23-15 could be considered to monitor only the southwestern-most corner of the S-SX WMA. While Figures 4.1 and 4.2 show plausible hypothetical groundwater plumes to explain the observations from well 299-W23-15, a description of the groundwater monitoring network which more clearly identifies what areas (spills and/or releases) and which tanks/ancillary equipment the monitoring wells are "monitoring" is very much needed in this chapter.

59. Page 3.1, Section 3.0, 1st paragraph. Delete the term "Phase I" and replace it with "first determination".

60. Page 3.1, Section 3.0, 1st paragraph. Although the contractor was contracted to perform work from August 1996 to 1997, it is Ecology's position that statistical exceedances (between up- and down-gradient wells) have been occurring since 1991 (Ecology, May 24, 1996). Therefore, the first determination may be concluded to have been occurring well before August 1996. Either delete "(August 1996 to August 1997)" or replace it with "(1991-1998)".

61. Page 3.1, Section 3.1, title of section. Change the word "co-contaminant" to "waste constituent".

62. Page 3.1, Section 3.1. Include an identification that groundwater samples have been filtered since early 1995. Describe the filtration process. Also, include a discussion of how filtration typically lowers the measurement of metallic ion concentrations. It is noted that all chromium drinking water exceedances (from wells 299-W23-14, 299-W22-39, 299-W23-15, 299-W22-44, 299-W22-45, and 299-W23-1 which occurred from 1991 to present were unfiltered samples.

63. Page 3.1, Section 3.1, 1st paragraph. Change the word "co-contaminants" to "constituents" in the first sentence.

64. Page 3.1, Section 3.1, 2nd paragraph. Tanks SX-108 and 109 are indicated as "the primary single-shell tank leak sources". As there is a history of spills and releases from other tanks in the SX tank farm, the basis for this particular statement must be included.

65. Page 3.1, Section 3.1, 2nd paragraph. Due to the significance associated with data collected by bailing versus purge and pump, include an appendix to the report that identifies how the various wells were sampled.

66. Page 3.1, Section 3.1, 3rd paragraph. Well 299-W23-1 is noted in the last paragraph as the only well in the vicinity of WMA S-SX currently showing an upward trend. Include an identification that an upward tritium trend has been observed at wells 299-W23-1, 299-W22-39, and 299-W22-45. An upward tritium trend has been observed at well 299-W22-39 since March 1994.

67. Page 3.1, Section 3.2, 1st paragraph. Change the word "co-contaminants" to "constituents" in the first sentence.

68. Page 3.4, Section 3.2. In a short summary, state what is the point of this section as it specifically relates to S/SX.

69. Page 3.4, Section 3.3, Figure 3.3. Include plots for tritium data collected from wells 299-W23-13 and 299-W23-1.

70. Page 3.4, Section 3.3. Add a discussion of tritium observations (upward trend in downgradient wells) from wells 299-W23-13, 299-W23-1, 299- W22-39, and 299-W22-46. The tritium plots for the 1995, 1996, and 1997 Hanford Site groundwater monitoring reports (Plate 3) appear to be indicating an upward tritium trend in the area near well 299-W23-1.

71. Page 3.6, Section 3.4. It is recommended that concentration contours maps for tritium and technetium-99 for fiscal years '95 and '96 are added to the report.

72. Page 3.5, Section 3.4, 3rd paragraph. The first sentence states the source areas for tritium and technetium-99 are clearly evident. Due to the '95, '96, and '97 Hanford Site groundwater monitoring reports (Plate 3) which show a trending tritium plume occurring in the north-eastern side of the S-SX WMA, include an explanatory basis for this statement.

73. Page 3.5, Section 3.4, 3rd paragraph. Delete the word "appears" in the second sentence. Recommended wording is: "Groundwater monitoring observations strongly suggest technetium-99 originates in the S and SX tank farm area while the highest concentrations of tritium originate to the west of the WMA near the upgradient crib sources noted above."

74. Page 3.5, Section 3.4, 3rd paragraph. The third sentence identifies other major downgradient sources and the fourth sentence provides an example of a sidegradient source. Recommended wording is: "It should also be noted that other major down- and side-gradient sources exist, especially for technetium-99. For example, the technetium-99 contours near the upper right corner of Figure 3.4 originated from side-gradient past-practice disposal sites associated with U Plant operations."

75. Page 3.5, Section 3.4, 4th and 5th paragraphs. The paragraphs do not appear to make any conclusions regarding the tritium observations. From Figure 3.5, it may be inferred that there are two different sources. Therefore, it may also be inferred that there are two different sources of the technetium-99 and the tritium. Include a discussion of the observations related to the tritium trend in the northeastern area of the S-SX WMA.

76. Page 3.5, Section 3.4, 5th paragraph. As the source of the technetium-99 has not been remediated, delete "(or was)" in the last sentence of the paragraph.

77. Figure 3.5. Upon review, the figure represents a useful generalization of observations. The text describing the figure indicates the data are an average of 1996 values for 12 wells. Considering the locations of the 12 data points and the statistical variation associated with the averaging (i.e., spatial and temporal), it is more accurate, at this time, to describe the information as representing a generalized relationship. In addition, it is indicated on page 3.5 that the expected tritium/technetium-99 ratio in downgradient wells is based upon "data and considerations provided in Agnew (1997)". Again, considering the potential error associated with the Agnew information, it is appropriate to describe the observed relationships as generalized and are to be evaluated/confirmed with additional data.

78. Figure 3.5. Figure 3.5 identifies data from well 299-W22-21 was used in its construction. Figure 1.2 does not appear to show this well. Include the well location on Figure 1.2.

79. Figure 3.5. The figure appears to include a data point for well 299-W22-10. According to Figure 1.2, this well appears to be downgradient to the 216-S-1,2 crib. Confirm if the well number is correctly indicated on Figure 3.5.

80. Figure 3.5. The data from well 299-W23-1 does not appear to be included in the plot. Include this well on the plot.

81. Figure 3.5. The data, if any exists, from well 299-W23-5, does not appear to have been included on the plot. If data exists for well 299-W23-5, include it on the plot.

82. Page 3.9, Section 3.5.1, 1st paragraph. The report does not appear to include hydrographs or data to explain the statement made in the second sentence concerning the declining water table. Include either data or hydrographs that reflect this information.

83. Page 3.9, Section 3.5.1, 1st paragraph. The issue associated with the declining water table and the requirement to perform further assessments of the contamination (40 CFR 265.93(d)(7)(i) by reference of WAC 173-303-400) will need to be resolved. It does not appear that an evaluation of the rate of decline (i.e., the remaining well life) has been performed. Include an evaluation in this section of the report.

84. Page 3.9, Section 3.5.1: There seems to be large variability in the tritium values as evidenced from the table. An explanation is required to define this anomaly. There are other constituents, which also show some anomaly (e.g. nitrate and Cs). Whatever the anomaly, it is important to note that this data is for samples taken within 7 feet of the surface. Do you have any idea what is going on at greater depth?

85. Page 3.9, Section 3.5.2. The discussion identifies 'the net effect is for significant retention of cesium-137 and strontium-90 in the vadose zone and/or on aquifer solids.' It is also noted that a tremendously large amount of information and data exist regarding the Cs-137 and Sr-90 vadose zone contamination. Therefore, include an identification in this section that Cs-137 and Sr-90 contamination has been confirmed in the vadose zone. In addition, include a reference in this section which identifies the Cs-137 and Sr-90 vadose zone contamination will be discussed in detail in Section 3.7 of this report.

86. Page 3.10, Table 3.1. The table's measured concentration for I-129 is indicated as 'NA' or not available. The HEIS database, however, indicates that sampling occurred and the results indicated values were below the detection limit of the analysis. Please update the table to reflect the 'less than detection limits' reported in HEIS.

87. Page 3.10, Table 3.1. The HEIS data indicates a May 23, 1997 tritium measurement of 64400 pCi/L. Although it is unknown if the measurement was from the "normal" or "shallow" sampling depth, the measurement is not reflected in the table. Please explain this discrepancy.

88. Page 3.11, Section 3.5.2, Top of the page: The alternative theory is not clear. The salt matrix is supposed to cover the clay surfaces and would effect the K_d values - a phenomenon expected to occur mostly in the vadose zone (under the defined scenario). Please clarify the details of the alternative theory and explain its impact on the discussion.

89. Page 3.11, Section 3.6: Although tritium plumes can substantiate to some extent the hydraulic conductivity information as presented in the figure, the other data (e.g. Tc-99) does not to support the conclusion. A superimposed plot of hydraulic conductivity and plume maps would clarify some of the conclusion made in this report. For example, it appears the mixture of hypothetical plumes of Tc-99 from tank leak and spill may occur closer to the Tank Farm (Figure 4.1) than depicted. Please clarify the language in this section to respond to these issues.

90. Page 3.13, Figure 3.8. On page 3.11 Figure 3.8 is based on information/data dating to or before 1992. If pump test data exists from newer boreholes, use all of the data to update this figure (i.e., to evaluate permeability variation).

91. Page 3.14-3.17, Section 3.7.2: It is not clear why the near surface gravel layer or deeper gravel layer (which is at/close to the water table) under the depicted scenario should act as conduit for lateral migration. In most cases the tanks are on top of the gravel layer. Some lateral migration might take place at the boundary of gravel layer and sand. This is unlikely since the conductivities and porosities are usually higher in sand than gravel. Does any field data exist to substantiate the premise in this section? If so, include the data and a more detailed explanation of the phenomena.

Was any perched water encountered (or very high soil moisture near the surface gravel layer, etc.)? From the observation of numerous crib (CERCLA) sites where millions of gallons of waste were discharged to the soil column, there is no evidence of having a perched water table or any similar hydrogeologic phenomenon close to the surface in the 200 Area. Include a discussion of these issues in this section.

92. Page 3.14, Section 3.7.1, 2nd paragraph. Include the actual measured concentrations of borehole 41-09-39 in the discussion particularly as it relates to the statement that concentrations were 1,000 to 10,000 times lower than maximum concentrations that occur above the gravel sequence. The last part of this paragraph is not clear. What do you mean by increase of likelihood of breakthrough to ground water? When you pump groundwater, you increase the vadose thickness and capillary fringe zone (shifting) above the water table. This section needs clarification.

93. Page 3.14, Section 3.7.1, 2nd paragraph. Initial groundwater samples at the top of the aquifer indicate hexavalent chromium is non-detectable (<10 μg/L) from borehole 41-09-39. It is not indicated whether or not the samples were filtered. The groundwater data as identified in HEIS indicates the groundwater samples for chromium have been filtered (wells 299-W22-46, 299-W22-39, 299-W22-45, 299-W23-15, and 299-W23-14) since early 1994. In addition, chromium concentrations measured at well 299-W23-7 in June 1996 were unfiltered and exceeded (53 μg/L) the chromium drinking water standard (.05 mg/L). Similarly,

chromium concentrations measured at well 299-W22-39 in November 1991, January 1992, July 1992, November 1992, June 1993, and March 1994 were unfiltered and exceeded (60, 83, 380, 100, 160, and 200 μg/L respectively) the chromium drinking water standard. Similarly, chromium concentrations measured at well 299-W22-46 in July 1992, November 1992, March 1993, June 1993, and March 1994 were unfiltered and exceeded (72, 70, 120, 130, and 120 μg/L respectively) the chromium drinking water standard. Therefore, identify if the sample(s) from borehole 41-09-39 were filtered. If filtered, include a discussion regarding the above observations including general conclusions of the effect of filtration related to ion measurements.

94. Pages 3.15 and 3.16, Figures 3.9 and 3.10. Figure 3.9 depicts contamination above 1 pCi/g and Figure 3.10 depicts contamination above 10 pCi/g. Due to the voluminous vadose zone characterization information available, the figures must either be redrawn to depict detectable low-level contamination below 1 pCi/g or provide a technical basis which justifies the non-importance of understanding low-level contamination in relation to the physical and chemical mechanisms of contaminant transport. Similarly, Figure 3.10 must be redrawn to include Cs-137 measurements above 10,000 pCi/g. The re-drawing should depict the high levels of contamination measured at boreholes 41-07-07, 41-09-09, and 41-00-08.

95. Pages 3.15 and 3.16, Figures 3.9 and 3.10. The figures depict a contamination perching effect occurring above the gravel and sandy gravel layers. The figures tend to depict the gravel and sandy gravel layers as conduits for lateral migration. While some degree of lateral migration may occur at such interface changes, the figures imply a relatively significant stratigraphic control. Include the basis for these interpretations (i.e., contaminant concentrations and/or moisture content measurements, perched water observations during drilling, etc.).

96. Pages 3.16, Figure 3.10. Figure 3.10 does not appear to include data from borehole 41-09-09. Either include this borehole data or provide justification for its exclusion.

97. Page 3.14, Section 3.7.2, 1st paragraph. After Figure 3.10 is re-drawn to reflect additional contamination data, include an identification that the postulated stratigraphic control near tank S-104 is not as highly correlated as expected.

98. Page 3.17, Section 3.7.3 Please discuss the increased amount infiltration in non-vegetated gravel tank farms. Discuss also the increase in infiltration due to umbrella effect of tank impervious domes. Increased impervious area concentrates recharge between tanks.

99. Page 3.17, Section 3.7.3, 2nd paragraph: There seems to be noticeable differences in soil moisture between shallow and deeper parts in certain wells (section AA, wells W23-14, and W22-39). Explain the observation.

100. Page 3.18, Section 3.8. Include an identification that the circumstantial evidence being referred to is the interpretation of data as depicted in Figures 3.9 and 3.10 which appears to be primarily based upon the contamination measured at borehole 41-09-39. This section should also include an identification that there is also considerably more circumstantial evidence that indicates there are numerous regions of "deep" contamination at the SX tank farm. This section should also identify that borehole 41-09-39 represents the deepest borehole from which vadose zone characterization information has been obtained and the vertical plume depicted in Figure 3.10 may largely be due to the lack of additional deep vadose zone data. This section should include a conclusion that it is not known at this time if the contamination is primarily transported via small vertical structures or if it occurs as a relatively large homogeneous plume.

101. Page 3.18, Section 3.8: Recently, PNNL has collected a lot of information and values on K_ds of a number of compounds/analytes that are more reasonable to use under different conditions. Use these values for consistency and accuracy.

102. Section 3.8. The section discusses technetium-99, cesium-137 and strontium-90 in relation to contaminant breakthrough. Although the chemical constituents are discussed in relation to analytical results in Appendix B, Section 3.8 does not reference the Appendix B constituents as contaminants which have been detected in the groundwater. In addition, Appendix B only contains data from '96 to '97, although much more data exists. Furthermore, pre-1996 groundwater data has been used in several sections of the document to discuss constituent patterns and relationships. Therefore, include a discussion of groundwater contaminant observations.

Aluminum represents an example of a groundwater constituent that should be discussed in the report. The HEIS data indicates aluminum concentrations have been measured since 1987. Aluminum observations range from non-detect (approximately 20 µg/L) to 13,000 µg/L (March 1994) and 18,300 µg/L (May 1997). From the HEIS entries, it appears groundwater samples were filtered beginning March 1994. With a few exceptions, filtered aluminum concentrations have been non-detect to relatively low compared to the non-filtered concentrations. The filtered groundwater samples may generally be described as resulting in aluminum measurements that are typically more than an order of magnitude lower than the non-filtered groundwater samples. In conclusion, the aluminum summary provided in Appendix B of the report incorrectly identifies that most of the aluminum results "are at or near detection limit". Describe all of the data and include a trend analysis of non-filtered aluminum measurements, if applicable.

Carbon tetrachloride also represents an example of a groundwater constituent occurring in the S-SX WMA monitoring wells that should be discussed in the

report. The HEIS data indicates carbon tetrachloride concentrations have been measured since 1992 at both up and downgradient S-SX WMA groundwater monitoring wells. Although measurements were not made consistently (from the same wells or at the same frequency), the observations collected thus far indicate that concentrations of carbon tetrachloride in downgradient wells have been greater than the respective concentrations observed in upgradient well 299-W-14 on at least two occasions (it should also be noted that carbon tetrachloride concentrations in upgradient well 299-W23-14 have only been measured four times since 1992). Furthermore, water quality standards for groundwater as established by WAC 173-200 for carbon tetracholoride (.3 μg/L) have been exceeded since 1997 by two orders of magnitude in well 299-W23-15. Carbon tetrachloride measurements as recorded in the Tank Waste Information Network System (TWINS) indicate that of the two tank farms (S and SX), only samples/cores from one tank (S-104) have been analyzed for carbon tetrachloride. Review of the core sample data indicates carbon tetrachloride was not detected. Similarly, TWINS data for vapor analyses indicates carbon tetrachloride was detected in the tank vapor headspace of tanks S-102 and S-106. It should be noted that the review of the TWINS data indicates that the vapor headspace of only seven tanks (SX-1, S-101, S-102, S-103, S-106, S-111, and S-112) were analyzed. A further review of the HEIS data has indicated that carbon tetrachloride has also been found in the 216-S-25 crib groundwater monitoring wells. The data also indicates the first 216-S-25 crib carbon tetrachloride observation occurred in July 1993 (1.2 μg/L) at well 299-W23-10. In comparison, the data indicates the first S-SX WMA carbon tetrachloride observation occurred in January 1992 (2.9 μg/L). Therefore, the report must include a discussion of carbon tetrachloride observations from the S-SX WMA and 216-S-25 crib groundwater monitoring network wells. In addition, the discussion should include the TWINS data base information regarding carbon tetrachloride analyses with an indication of which tank wastes and/or headspaces were sampled. In addition, if vadose zone carbon tetrachloride data exists, that data should also be included in the discussion.

Nitrate, potassium, and fluoride should also be discussed in this report. In particular, it is appropriate to statistically compare the upgradient to the downgradient concentrations.

103. Page 4.1, Section 4.1, 1st paragraph. Delete the term "Phase I" as it has no regulatory meaning. Recommended wording for the first sentence is: "As part of this first determination groundwater assessment, an attempt..."

104. Page 4.1, Section 4.1, 1st paragraph. As more hypothetical scenarios exist to explain the contamination observations, recommended wording for the second sentence is: "For this purpose, the following three scenarios are considered:".

105. Page 4.1, Section 4.1.1, 1st paragraph. Identify that the "SX Tank Farm Report" (DOE/ID/12584-268, GJPO-HAN-4, September 1996) tank-by-tank vadose zone

characterization discussions (Section 10.2) do not support this scenario. It should also note that the report identifies substantial surface contamination above most SX tanks, which does not appear to be addressed by this scenario.

106. Page 4.1, Section 4.1.2, 1st paragraph. Identify that the "SX Tank Farm Report" (DOE/ID/12584-268, GJPO-HAN-4, September 1996) tank-by-tank vadose zone characterization discussions (Section 10.2) do not support this scenario. It should also note that the report identifies substantial surface contamination above most SX tanks, which does not appear to be addressed by this scenario.

107. Page 4.3, Section 4.1.3, 1st paragraph. Identify that the "SX Tank Farm Report" (DOE/ID/12584-268, GJPO-HAN-4, September 1996) tank-by-tank vadose zone characterization discussions (Section 10.2) do not support this scenario. It should also note that the report identifies substantial surface contamination above most SX tanks, which does not appear to be addressed by this scenario.

108. Page 4.5, Section 4.2.1, 2nd paragraph. Identify the potential pore volume associated with utility line leakage. From the discussion occurring in Section 4.2.2, line leakage may easily represent multiple pore volumes. Recommended wording to add to the end of the second paragraph is: "It should be noted that this comparison does not include consideration of utility line leakage."

109. Page 4.5, Section 4.2.2, 1st paragraph. The last sentence indicates a high potential for a significant volume of utility line leakage. If records and/or estimates of volumes associated with this practice exist, they should be included as an appendix to this report.

110. Pages 4.5 - 4.9, Section 4.2.2. The discussion of utility line leakage and the comparison to specific conductivity observations is particularly important 1) in understanding contaminant transport and 2) for identifying objectives associated with future monitoring of the contamination plumes.

The first full paragraph on page 4.7 describes an eight-foot cottonwood tree and Figure 4.4 provides a photograph of the tree flourishing among the sagebrush. From this information, an approximation of the age of the tree and the water required for the tree to survive may be made. It is requested that these approximations be included in the report.

Specific conductivity as an indicator parameter should be discussed and/or analyzed in more detail. The discussion should include data analyses and an evaluation of all specific conductivity measurements (which began in 1994 at well 299-W23-14, 1992 at well 299-W23-15, 1992 at well 299-W22-45, 1992 at well 299-W22-21, 1991 at well 299-W22-39, and 1992 at well 299-W22-46). Section 4.2.2 provides a good, but incomplete discussion of specific conductivity observations and/or comparisons. Neither the discussion in Section 4.2.2 nor

Appendix B provides an explanation or a derivation of the mean natural background value of 344 μmhos/cm for groundwater upgradient of Hanford facilities. More importantly, the assessment does not provide justification for using the mean natural background rather than the upgradient average background. Most importantly, the assessment report does not appear to compare specific conductivity observations from upgradient monitoring well 299-W23-14 to downgradient monitoring wells. Furthermore, the Appendix B discussion completely omits discussion of utility line contributions/effects to specific conductivity observations. The report must include all data used to derive the statistical mean for the upgradient well(s) and include an explanation and/or equation identifying how the specific conductivity measurements were averaged to obtain the background. Note: a cursory review of specific conductivity measurements collected from upgradient well 299-W23-14 from September 1994 to May 1998 yielded an average specific conductivity of 241 μmhos/cm. This average falls within the stated "general background from a waste source" category range of 225-260 μmhos/cm. Also, a cursory review of specific conductivity measurements collected since 1994 indicates specific conductivity measurements from downgradient wells were consistently higher than from upgradient wells (299-W23-14 and 299-W23-13) until February 1996. Of interest, from February 1996 to May 1998, at RCRA downgradient wells 299-W23-15, 299-W22-46, and 299-W22-39, specific conductivity measurements were lower than those collected from RCRA upgradient well 299-W23-14.

The discussion on page 4.7 predicts lower observed values for specific conductivity measurements due to utility line leaks. This generalization appears to explain the observations for the SX tank farm, but lower specific conductivity values are not observed in S tank farm downgradient monitoring wells (as reflected by Figure 4.3 and HEIS data). Therefore, it may be appropriate to apply two separate specific conductivity analyses (comparisons between upgradient and downgradient wells), one for the SX tank farm wells (299-W23-14, 299-W23-15, 299-W22-46, and 299-W22-39) and one for the S tank farm wells (299-W23-13, 299-W23-1, 299-W23-7, and 299-W22-45).

111. Page 4.7, Section 4.2.2, 2nd full paragraph. The first sentence indicates the specific conductance in the vicinity of the S and SX tank farms is much lower than natural groundwater for the Hanford Site. Although it is agreed that the specific conductance is lower in the S-SX WMA area, this sub-section does not discuss any comparisons between up and downgradient wells. As a generalization, upgradient well 299-W23-13 specific conductivity measurements are lower than downgradient well 299-W22-45. Similarly, upgradient well 299-W23-14 specific conductivity measurements are lower than downgradient wells 299-W23-15 (September 1994-August 1995), 299-W22-39 (September 1994-February 1996), and 299-W22-46 (September 1994-August 1995 and November 1996-May 1998) and 299-W22-45 (September 1994-May 1998). Include a

statistical evaluation to determine if any of the downgradient increases are statistically significant.

112. Page 4.6, Figure 4.3. The 1997 conductivity contour inset should identify that the 299-W23-7 measurement of 160 μmhos/cm represents the only measurement collected for 1997 and that it was collected by bailing. In addition, include an explanation how the contours were developed, (i.e., if all the well data were averaged).

113. Page 4.9, Section 4.2.3. The second paragraph indicates that well 299-W23-1 is an older well with a "poor or uncertain seal". Include an identification that the well was "remediated" in 1976 by perforating the 6-inch screen, installing a 4-inch casing, and grouting the annulus (*Assessment Groundwater Monitoring Plan for Single Shell Tank Waste Management Area S-SX*, WHC-SD-EN-AP-191, Rev.0). Also identify if there have been any measurements of gamma (in)activity from well 299-W23-1.

114. Page 4.9, Section 4.2.3. According to *Assessment Groundwater Monitoring Plan for Single Shell Tank Waste Management Area S-SX*, WHC-SD-EN-AP-191, Rev.0, the "listed use" of many of the S-SX WMA groundwater monitoring wells were "SST monthly water level measurements". For example, groundwater level measurements were collected on a monthly basis at well 299-W23-6 from June 1989 to March 1993, well 299-W23-7 from July 1974 to March 1993, well 299-W23-8 (which does not appear to be shown on Figure 1.2) from December 1989 to March 1993, well 299-W23-12 from July 1991 to March 1993, well 299-W22-39 from July 1991 to March 1993, well 299-W22-45, well 299-W22-46 from January 1992 to March 1993, well 299-W23-13 from July 1991 to March 1993, well 299-W23-14, from July 1991 to March 1993, well 299-W23-15 from January 1992 to March 1993, well 299-W23-2 from August 1955 to November 1992, and well 299-W23-3 from May 1956 to March 1993. Comparing the snow melt events to water level measurements (hydrographs) may yield correlations which may add to the discussion but are currently lacking.

115. Page 5.1, Section 5.0, 1st paragraph. There is no regulatory basis for the term "Phase I". Replace the term with "first determination assessment of 40 CFR 265.93(d) (by reference of WAC 173-303-400)".

116. Page 5.1, Section 5.0, 1st bullet. Radionuclides are considered to be waste constituents. Recommended wording for the first bullet is: "Distribution patterns for tank waste constituents (radionuclides, nitrate, chromate, etc.) in the vicinity of WMA S-SX indicate this WMA has contributed to groundwater contamination observed in downgradient monitoring wells."

117. Page 5.1, Section 5.0, 2nd bullet. Due to the spatial and temporal groundwater observations of contamination occurring at wells 299-W23-2 (1987-1989) and

299-W23-7 (1987 – 1989), at least four WMA source areas are needed to explain the technetium-99 observations at well 299-W23-7 and the technetium-99 and nitrate observations at well 299-W23-2. Considering the spatial and temporal vadose zone observations of radionuclide contamination, there could easily be more than four "source areas". Re-write the bullet to identify the additional groundwater observations occurring at wells 299-W23-2 and 299-W23-7 and include the appropriate identification of the vadose zone characterization information.

118. Page 5.1, Section 5.0, 3rd bullet. Please explain the drinking water standard of 45,000 μg/L used at this point. The groundwater quality criterion of WAC 173-200-040 for nitrate (as N) is 10 mg/L.

119. Page 5.1, Section 5.0, 3rd bullet. The bullet could be interpreted to imply there is a limitation to the contamination at and/or near wells 299-W22-46, 299-W23-6, and 299-W23-1. Tank waste constituents have re-occurred at wells 299-W23-1, 299-W22-39, 299-W22-46, 299-W23-7, etc. Include an identification of such re-occurrences in this bullet.

120. Page 5.1, Section 5.0, 3rd bullet. An observation of nitrate higher than the water quality criteria (10 mg/l) has occurred at well 299-W23-3 as recently as July 1995 (the most recent nitrate measurement at this well is 17 mg/l). Similarly, the most recent nitrate observations at well 299-W23-2 (15 mg/l measured March 1996), at well 299-W23-15 (11 mg/l measured February 1996), at well 299-W22-39 (17mg/l measured February 1996) all exceeded water quality criteria. Therefore, although it has been more than two years after nitrate was measured at most of these wells, it is unknown if nitrate is currently limited to well 299-W22-46 at this time. Either describe the most recent nitrate measurements at wells 299-23-3, 299-W23-2, 299-W23-15, and 299-W22-39 or re-write the sentence to identify that the limit of the nitrate water quality standard exceedances is unknown at this time.

121. Page 5.1, Section 5.0, 4th bullet. Either re-write the bullet to identify that since February 1996 (with only one exception), the groundwater samples collected for chromium analysis have been filtered and the decrease noted will have to be confirmed by analysis of unfiltered samples. The other alternative is to delete chromium from this trend.

122. Page 5.1, Section 5.0, 4th bullet. Delete the second sentence of the bullet. The identification of future actions/determinations should be placed in Section 6.0.

123. Page 5.1, Section 5.0, 5th bullet. The term "short-term contaminant transients" is not clear. From the discussion and the data, perhaps "recurring contaminant transport" or "a mechanism for recurring contaminant transport" is more

applicable wording for this phenomenon. If the term "short-term contaminant transients" is used, also provide a definition or explanation of the term.

124. Page 5.1, Section 5.0, 6th bullet. The HEIS data base indicates cesium-137 was detected at the following wells: 299-W22-46 (April 1992, July 1992, November 1992, and May 1997), 299-W22-39 (November 1991, January 1992, April 1992, and July 1992), and 299-W22-45 (April 1993). Identify and/or discuss these occurrences in relation to the conclusion.

125. Page 5.1, Section 5.0, 7th bullet. According to the HEIS data base, low but detectable cesium-137 was also found in another old well 299-W23-1. Include this information in the bullet. Also, include an identification that extensive vadose zone characterization information exists which confirms the presence of broadly distributed cesium-137 contamination. While it is important to determine if there is a communication pathway via the groundwater monitoring well from the S-SX WMA to the aquifer, an identification of the characterized vadose zone and the broad distribution of cesium-137 contamination should also be identified in this bullet or in another bullet.

126. Page 5.2. Again, nature and extent of contamination determination is needed for groundwater and soil zone.

127. Page 5.2, Section 5.0, 1st bullet. Insert the word "constituents" between "waste" and "reached" in the first sentence of the bullet. Also, identify in this bullet if the chromium samples were filtered prior to analysis.

128. Page 5.2, Section 5.0, 2nd bullet. Recommended re-wording is: "Further data are needed to monitor and/or determine the nature, extent, and source(s) of groundwater contamination (including recurrent contamination) attributed to WMA S-SX."

129. Section 6.0, General Comment. Section 6 does not satisfy the requirements of 40 CFR 265.93(d) in that the proposed actions do not describe how the rate and extent of migrating contamination will be delineated and monitored. In addition, even though the first determination has occurred over an extended period of time and the confirmation of multiple releases from the S-SX WMA has been adequately substantiated, the section discusses a scenario by which the monitoring program may return to a "detection monitoring status". This implies either a lack of understanding of RCRA groundwater regulations or a conclusion that the S-SX WMA has not released hazardous waste constituents to the groundwater. The option to return to an indicator parameter monitoring program (as allowed by 40 CFR 265.93(d)(6)) occurs only when the owner/operator determines, based on the results of the first determination that groundwater has not been impacted by the unit. To explain further, if "no hazardous waste or hazardous waste constituents from the facility have entered the groundwater," then the owner/operator "may

reinstate the indicator evaluation program." Therefore, Section 6 should be re-written to clearly identify what actions will be taken to delineate and monitor the rate and extent of migrating contamination from the S-SX WMA. For a minimum frequency of further determinations (of the assessment monitoring program), refer to 40 CFR 265.93(d)(7)(i).

130. Page 6.1. This section is missing any discussion of nature and extent proposed plans for vadose zone.

131. Page 6.1. Criteria for returning WMA unit to detection monitoring are premature at this point. Emphasis should be put on defining nature extent of contamination and possible corrective action.

132. Page 6.1, Section 6.0 title. Recommended re-wording is: "Proposed Further Determinations".

133. Page 6.1, Section 6.0, 1st paragraph. Recommended re-wording for the first sentence is: "The objectives of the proposed further determinations (required by 40 CFR 265.93(d)(7)(i) [by reference of WAC 173-303-400]) are: 1) to further delineate the nature and extent of migrating contamination (vadose and groundwater) associated with the S-SX WMA to support possible corrective action actions and/or options; 2) to understand the geochemical reactions tank waste constituents undergo in the vadose zone and groundwater; 3) to determine the appropriate tank waste constituents, reaction products and/or indicator parameters (including frequencies) to monitor; and 4) to assess the fitness-for-use of older non-RCRA compliant wells within the WMA."

134. Page 6.1, Section 6.0. 2nd paragraph. Change "Phase II" to "further determinations of 40 CFR 265.93(d)(7)(i) (by reference of WAC 173-303-400)".

135. Page 6.1, Section 6.0, 2nd paragraph bullets. The bullets must clearly identify which groundwater monitoring wells will be sampled, the frequency (quarterly) of sampling, and the constituents and parameters to be monitored. Note: due to the past filtration of samples, the bullets must identify that groundwater samples will not be filtered.

136. Page 6.1, Section 6.0, 3rd paragraph. Delete the first sentence that describes the three "if" scenarios by which indicator monitoring may be resumed. This is not an option as releases from the S-SX WMA to the groundwater have been confirmed.

137. Page 6.1, Section 6.0, 3rd paragraph. Well 299-W22-44 should be removed from the quarterly monitoring program, as the well does not adequately represent a downgradient well located at the S-SX WMA's "point of compliance".

138. Page 6.1, Section 6.0, 3rd paragraph. The proposed upgrades should be based upon well-specific data and should clearly identify what work/upgrades will be performed on which wells.

139. Page 6.1, Section 6.0, 4th paragraph bullets. The bullets need to describe and/or indicate specific actions. For example, the first bullet should identify which wells will be sampled for which constituents. As another example, the second bullet should either identify the conditions for the "if necessary" qualifier or remove the qualifier and identify that monthly measurements will be made. Note: due to the filtration of chromium, no determination can be made on any chromium concentration trends.

140. Page 6.1, Section 6.0, 4th paragraph, 3rd bullet. Include the basis for using well 299-W23-9 as an upgradient well for constituent concentration comparison purposes. Considering the direction of groundwater flow and the location of well 299-W23-9, this well does not appear to represent a well that will yield a representation of groundwater quality passing the upgradient unit boundary of the S-SX WMA.

141. Page 6.1, Section 6.0, 4th paragraph, 4th bullet. The large volume pumping is noted to be approximately 1040 gallons. Prior to approving this action, a plan describing how the well purging will be performed must be submitted for review. The plan should identify the rate of purging, a description of how purging will be performed, the sampling intervals, a description of well history, a description of well development, an identification of sampling parameters, etc.

142. Page 6.1, Section 6.0, 4th paragraph, 5th bullet. The selective moisture content measurement is noted. As moisture and/or water sources may account for periodic occurrences of groundwater contamination, a plan describing how the moisture logging will be performed across the S and SX farms must be submitted for review prior to approval.

143. Section 6.0. Include an identification of actions to be taken to further delineate the rate and extent of migrating contamination in the vadose zone.

144. Section 6.0. Include an identification of actions to be taken to identify and eliminate potential water sources (i.e., leaking water lines, water logging, rupture events, etc.) within and around the tank farms.

145. Page 6.2. Regulators will approve this subsequent workplan for phase II. A discussion of how this phase II ties into an RFI process is needed. Also discuss how all of this will be tied into the site-wide permit process.

146. Page 6.2. Owner operators of TSD facilities impacting groundwater are obligated to proceed to corrective action phase. This can be and should be self-imposed by the owner/operator.